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(74) Agents: WADSWORTH, Philip, R. et al.; Qualcomm Incorporated, 5775 Morehouse Drive, San Diego, CA 92121-1714 (US).

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(71) Applicant: QUALCOMM INCORPORATED [US/US];
5775 Morehouse Drive, San Diego, CA 92121-1714 (US).

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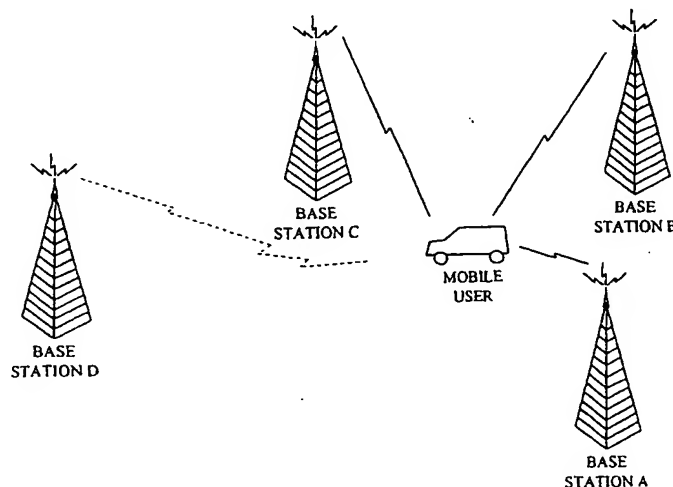
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(72) Inventor: AMERGA, Messay; Apartment 119, 8929 Lombard Place, San Diego, CA 92122 (US).

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(54) Title: MODIFIED FINGER ASSIGNMENT ALGORITHM FOR HIGH DATA RATE CALLS



(57) Abstract: A method and communication system for assigning the plurality of fingers to demodulation paths in a path list which insures that at least one finger will be assigned to a demodulation path supporting a supplemental channel, if one exists. The method involves determining whether any of the fingers is demodulating a supplemental channel. When no fingers are demodulating supplemental channels, it is determined whether the sector containing the path under consideration supports supplemental channels. If the sector containing the path under consideration supports supplemental channels, then the method determines the strength of the signal path relative to the weakest finger. If the path is a certain amount greater in strength than the weakest finger, then the method involves reassigning that finger to the path with the supplemental channel and if the path with the supplemental channel is a certain amount of strength weaker than the weakest finger plus a certain value, then the method involves determining whether the weakest finger is the only one supporting the supplemental channel.

WO 01/20803 A1



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MODIFIED FINGER ASSIGNMENT ALGORITHM FOR HIGH DATA RATE CALLS

BACKGROUND OF THE INVENTION

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I. Field of the Invention

The present invention relates to communications systems, particularly to an improved finger assignment method for high data rate ("HDR") calls in a communication system capable of receiving multiple signals.

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II. Description of the Related Art

The next generation of wireless networks will provide multiple services requiring high data rate transmission and uninterrupted connections. This next generation is often referred to as the "third generation" of CDMA wireless systems. The range of services include text paging, two-way radio connections, internet connectivity using microbrowsers, two-way wireless e-mail capability and wireless modem functionality. The CDMA cellular telephone system offers the capability to provide reliable radio links between a wireless communications device such as a mobile station ("MS") and a base station ("BS") with a much higher data capacity than conventional networks that only support voice service. As an example, in the third generation CDMA wireless systems, radio links supporting high rate (up to 2 Mbps) data transmissions will be established between the MS and the BS to provide multimedia services such as Internet access.

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One particularly important feature of CDMA systems for effective third generation wireless communication is the soft handoff, which allows the MS to move smoothly from the coverage of one cell to another without interruption of service to the user. The soft handoff is accomplished by establishing simultaneous communications between the MS and multiple base stations or BS sectors. In a soft handoff, a MS passes to the edge of the coverage area of a serving BS into a new coverage area of a receiving BS. Momentarily, both BS sectors simultaneously communicate with the MS. As the MS passes further

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into the coverage area of the receiving BS, the server BS stops communicating with the MS. In this manner, there is uninterrupted communication for the user of the MS as the he or she passes from the server cell to the receiving cell. An efficient soft handoff algorithm plays an important role in maintaining the link quality as well as conserving the capacity-related network resources. As the demand to support high rate data services increases, the need to improve the efficiency of the handoff algorithm becomes more critical.

For a third generation system based on CDMA technologies, a highly efficient handoff algorithm is essential to successfully provide the infrastructure to support the new range of services. A conventional protocol for soft handoffs in a CDMA system has been adopted by the Telecommunications Industry Association in the industry standards IS-95, IS-95 A or IS-95 B (collectively "IS-95 A/B") for implementing a CDMA cellular system. A new feature in the IS-95 B standard not found in IS-95 A is the inclusion of Supplemental Code Channels, or Supplemental Channels within the Traffic Channels. The Traffic Channels are the communication path between the MS and the BS used for user voice and signaling traffic. The term Traffic Channel includes the forward channel from the BS to the MS and the reverse channel from the MS to the BS.

In a code division multiple access (CDMA) cellular telephone system, a common frequency band is used for communication with all base stations in a system. The common frequency band allows simultaneous communication between a mobile station and more than one BS. Signals occupying the common frequency band are discriminated at the receiving station through the spread spectrum CDMA waveform properties based on the use of a high speed pseudonoise (PN) code. The high speed PN code is used to modulate signals transmitted from the base stations and the mobile stations. Transmitter stations using different PN codes or PN codes that are offset in time produce signals that can be separately received at the receiving station. The high speed PN modulation also allows the receiving station to receive a signal from a single transmitting station where the signal has traveled over several distinct propagation paths.

A signal having traveled several distinct propagation paths is generated by the multipath characteristics of the cellular channel. One characteristic of a multipath channel is the time spread introduced in a signal that is transmitted through the channel. For example, if an ideal impulse is transmitted over a multipath channel, the received signal appears as a stream of pulses. Another characteristic of the multipath channel is that each path through the channel may cause a different attenuation factor. For example, if an ideal impulse is transmitted over a multipath channel, each pulse of the received stream of pulses generally has a different signal strength than other received pulses. Yet another characteristic of the multipath channel is that each path through the channel may cause a different phase on the signal. For example, if an ideal impulse is transmitted over a multipath channel, each pulse of the received stream of pulses generally has a different phase than other received pulses.

In the mobile radio channel, the multipath is created by reflection of the signal from obstacles in the environment, such as buildings, trees, cars and people. In general the mobile radio channel is a time varying multipath channel due to the relative motion of the structures that create the multipath. Therefore, if an ideal impulse is transmitted over the time varying multipath channel, the received stream of pulses would change in time location, attenuation, and phase as a function of the time that the ideal impulse was transmitted.

The multipath characteristic of a channel can result in signal fading. Fading is the result of the phasing characteristics of the multipath channel. A fade occurs when multipath vectors are added destructively, yielding a received signal that is smaller than either individual vector. For example if a sine wave is transmitted through a multipath channel having two paths where the first path has an attenuation factor of X dB, a time delay of δ with a phase shift of Θ radians, and the second path has an attenuation factor of X dB, a time delay of δ with a phase shift of $\Theta + \pi$ radians, no signal would be received at the output of the channel.

In narrow band modulation systems such as the analog FM modulation employed by conventional radio telephone systems, the existence of multiple paths in the radio channel results in severe multipath fading. As noted above

with a wideband CDMA, however, the different paths may be discriminated in the demodulation process. This discrimination not only greatly reduces the severity of multipath fading but provides an advantage to the CDMA system.

The deleterious effects of fading can be mitigated by controlling
5 transmitter power in the CDMA system. A system for BS and MS power control is disclosed in U.S. Pat. No. 5,056,109 entitled "METHOD AND APPARATUS FOR CONTROLLING TRANSMISSION POWER IN A CDMA CELLULAR MOBILE TELEPHONE SYSTEM," issued Oct. 8, 1991, assigned to the Assignee of the present invention. Furthermore the effect of multipath fading can be
10 reduced by communication with multiple base stations using a soft handoff process. A handoff process is disclosed in U.S. Pat. No. 5,101,501 entitled "SOFT HANDOFF IN A CDMA CELLULAR TELEPHONE SYSTEM," issued Oct. 8, 1991, and assigned to the Assignee of the present invention. The disclosure of U.S. patents 5,056,109 and 5,101,501 are incorporated herein by reference.

15 A method of assigning multiple demodulation elements or fingers in a spread spectrum system is disclosed in U.S. Pat. No. 5,490,165 ("the '165 patent"), which disclosure is incorporated as if fully set forth herein. Accordingly, background information and familiarity with the '165 patent are presumed for the present invention. The '165 patent is assigned to the Assignee
20 of the present invention.

In the '165 patent, the MS using a searcher element scans a window of time offsets around the nominal arrive time of each signal of each BS with which active communication is established. The set of base stations having active communication with the MS is called the Active Set. Each scan produces
25 a survey yielding a list of survey paths that comprises pilot signal strength, time offsets, and corresponding BS pilot offset. The survey paths have corresponding data such as the arrival time, signal strength, and transmitter index for each signal. The searcher element passes the information to a controller. The controller tries to match the time offset of each survey path to
30 the time offset of paths currently being demodulated by the fingers. If there are multiple demodulation paths that match one survey path, all fingers or demodulation elements assigned to that path, except the demodulation element

having the strongest signal strength indication, are labeled "free." If a demodulation path exists that does not correspond to a survey path, a survey path entry based on the demodulation path information is added to the list of survey paths.

5 Next the controller considers the survey paths in order of signal strength with the strongest signal strength survey path being first. If there is no demodulation element assigned to any path in the corresponding sector of the survey path under consideration, the controller attempts to assign a demodulation element to the survey path in the following order. If there is an
10 unassigned or labeled "free" demodulation element, the demodulation element is assigned to the survey path. If no demodulation element is free, the demodulation element having the weakest path that is not the only demodulation path from its BS sector, if any, is re-assigned to the survey path. Finally if the first two cases fail to assign a demodulation element to the survey
15 path, a demodulation element assigned to the weakest path is reassigned to the survey path if the survey path's signal strength is stronger than the signal strength of the weakest demodulation path. This process continues until one re-assignment occurs or until the last criteria fails to re-assign a demodulation element to the survey path under consideration.

20 If none of the above rules re-assign a demodulation element for the present survey path, the controller considers the survey paths again in order of signal strength with the strongest signal strength survey path being first. If the survey path is not currently assigned to a demodulation element, the controller may assign any unassigned or labeled "free" demodulation element to the
25 survey path under consideration. If there are no unassigned or labeled "free" demodulation elements, the controller may also re-assign a demodulation element that is assigned to the same BS sector as a survey path if the survey path is stronger than the demodulation path. The controller may also re-assign the weakest demodulation element that is assigned to any BS sector having two
30 or more assigned demodulation elements if the survey path is stronger than the demodulation path. Once either of the two above rules causes a re-assignment

or both of the above rules for re-assignment fail for the survey path under consideration, the process begins again with a new scan.

The '165 patent uses these steps to ensure BS and sector diversity. Each time a demodulation element or finger is re-assigned, a finite time lapses in which no data is demodulated. Therefore, the prior art to the '165 patent limited the number of demodulation element re-assignments per survey. Comparison ratios are used to create hysteresis in the assignments and thus reduce excessive re-assignment of demodulation elements.

The BS uses a similar but less complicated method to assign the demodulation elements. Because each BS sector receives the same information from a single MS, there is no need to sacrifice the maximum signal level paths to promote diversity. Thus the BS method is based more strictly on signal level while limiting the number of re-assignments per survey similar to the MS method. The BS also uses ratios similar to the mobile station to create hysteresis to reduce excessive re-assignment of demodulation elements

Under the current IS-95 B specifications, a MS may have up to six sectors in its Active Set. The MS may be receiving data at a higher rate on any or all of these sectors. Due to hardware limitations, however, a MS may not have enough demodulating fingers to track all the paths it detects. Therefore, a MS in a soft handoff during a higher data rate call may ignore base stations transmitting on Supplemental Channels under the finger assignment algorithm as disclosed in the '165 patent.

The Supplemental Channel is an optional portion of a forward or reverse Traffic Channel, which operates in conjunction with a Fundamental Code Channel in the Traffic Channel and optionally with other Supplemental Channels to provide higher data rate services. The Fundamental Code Channel is also a portion of the forward or reverse Traffic Channel which carries a combination of primary data, secondary data, signaling and power control information defined and organized according to the IS-95 B industry standard. The Supplementary Channel transmits a combination of primary data, secondary data, or both, but never signaling formation.

The '165 patent relates to "voice only" systems and therefore does not teach tracking the Supplemental Channels which may be providing supplemental data to the MS separate from a Traffic Channel used for a voice conversation. By not tracking a Supplemental Code Channel, data may be lost
5 when the communication path is temporarily severed during a soft handoff, or when a four way handoff occurs. The following example demonstrates the problem.

FIG. 2 illustrates a four-way soft handoff where the MS has three fingers available to track paths. Base stations A, B, C, and D are all in the Active Sector
10 of the MS on a HDR call. The finger assignment algorithm will select the strongest paths from base stations A, B and C to match up with the fingers since those are the cells indicating the strongest signals. If BS D is the only station transmitting a Supplemental Channel, then the MS will not be demodulating the Supplemental Channel, resulting in an radio link protocol (RLP)
15 resynchronization at the MS.

Data may also be lost or an interruption of communication may occur if the MS is in a handoff and the MS has Y fingers available to track paths, and the BS sectors that are transmitting supplemental channels are the $(Y + 1)^{th}$ to last strongest pilots received by the MS. In other words, if the MS has for example 4
20 fingers available to track paths and the base stations transmitting on supplemental channels is the 5th strongest pilot received by the MS, then the supplemental channel will not be demodulated and the information will not be communicated to the MS under the method taught in the '165 patent.

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SUMMARY OF THE INVENTION

In order to address the problem of possibly losing supplemental channels in a soft handoff, the invention disclosed herein is proposed. The present invention insures that at least one finger will be assigned to a cell that is transmitting supplementals, if one exists. If one or more fingers are already
30 demodulating supplemental channels, then the finger assignment algorithm will proceed normally. The present invention provides an improved finger assignment algorithm to that shown in Fig. 5A - 5D of the '165 patent.

Throughout the disclosure, the use of the terms 'demodulation element' and 'finger' are used interchangeably.

According to the present invention, a communication system comprises at least one base station, a mobile station transmitting and receiving
5 communications signals to and from the at least one base station, a control system which assigns fingers to demodulate communication signals received by the mobile station, the control system determining after all the fingers have been assigned to demodulate communication signals whether any of the fingers are demodulating communication signals on supplemental channels. The
10 control system reassigns a finger to demodulate a supplemental channel if no fingers assigned are presently demodulating communication signals on the supplemental channel. One of ordinary skill in the art will understand the necessary implementation of the above structure.

The present invention is also directed to a method of assigning the
15 plurality of fingers to insure that at least one finger will be assigned to a cell or sector that is transmitting on a supplemental channel, if one exists. The method involves the mobile station or receiver having a plurality of fingers or demodulation elements, and assigning the plurality of fingers to a plurality of signals from the base station or base stations. The method comprises measuring
20 the plurality of signals from the base stations beginning with the strongest to the weakest, creating electronic representations of a list of survey paths of each of the plurality of signals, matching a list of demodulation paths corresponding to signals being demodulated by the mobile station to the list of survey paths, determining whether each of the plurality of fingers is matched to one of the
25 plurality of signals, and determining whether any of the fingers is demodulating a supplemental channel. When no fingers are demodulating supplemental channels, the method further comprises determining whether the cell containing the demodulation path being demodulated by the finger supports supplemental channels. If the cell containing the demodulation path
30 being demodulated supports supplemental channels, then the method determines whether the strength of the demodulation path being demodulated is a certain amount greater in strength than the weakest finger, and if yes, the

method reassigns that weakest finger to the demodulation path from the cell supporting the supplemental channel. If the strength of the demodulation path with the supplemental channel is not a certain amount greater than the weakest finger, the method begins a new scan of the survey paths beginning with the
5 strongest path.

When there are fingers already demodulating supplemental channels, the method inquires whether the strength of weakest finger is at least 3dB weaker than the strength of the demodulation path. If yes, the method determines whether the weakest finger is the only one supporting the
10 supplemental channel. If no, then the method reassigns that finger to the demodulation path. If yes, then the method asks whether the sector containing that demodulation path supports supplemental channels. If yes, then the method reassigns that finger to the demodulation path. If no, the sector does not support supplemental channels, then the method asks whether the call is a
15 high data rate call with supplemental channels and fingers not demodulating supplemental channels. If the strength of the weakest finger is 3dB or less weaker than the demodulation path, the method also determines the same question above, namely, whether the call is a high data rate call with supplemental channels and fingers not demodulating supplemental channels.

20 In both cases above where the query is whether the call is a high data rate call with supplemental channels and fingers not demodulating supplemental channels, if yes, then the method determines whether there are more paths on the path list. If there are more paths on the path list, the next strongest path on the list is assigned as the demodulation path under
25 consideration and the method continues again as described above. If no, there are no most paths on the path list, then the method continues to assign fingers for path diversity. If the HDR call with supplemental data is being demodulated by a finger, then the method continues to assign fingers for path diversity.

30 Therefore, if the weakest finger is the only one supporting supplemental channels, and the cell supports supplemental channels, then that finger is assigned to the survey path P with the supplemental channel, although that

path P may normally not be assigned a finger because it is the 4th strongest survey path where the mobile station has only 3 fingers or demodulation elements, as an example. In this manner, the present invention insures that the information on a supplemental channel is always demodulated by a demodulation element during a soft-handoff in a high data rate call.

BRIEF DESCRIPTION OF THE DRAWINGS

The features, objects, and advantages of the present invention will become more apparent from the detailed description set forth below when taken in conjunction with the drawings in which like reference characters correspond throughout and wherein:

FIGS. 1A-1D are a detailed example of the demodulation element assignment method for a mobile station according to the present invention;

FIG. 2 illustrates a four-way hand-off situation; and

FIGS. 3A-3C illustrate the pilot signal strength versus time for three different base stations or base sectors.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1A-1D illustrate the improved finger assignment algorithm according to the present invention over the teachings of the '165 patent. In FIGS. 1A-1D, it is assumed that there are three demodulation elements or fingers available for assignment. A control system for operating the algorithm and methods illustrated by the flow charts is not shown. Such control system may be deployed in the MS, the BS or both. Implementing the method and algorithm disclosed and claimed herein by a control system would be understood by one of ordinary skill in the art.

Many other embodiments of the present invention will be readily apparent upon considering the implementation of FIGS. 1A-1D. For example, the number of demodulation elements may be more or less than three. Therefore FIGS. 1A-1D are not meant to limit the present invention but are meant to serve as a preferred embodiment.

FIG. 1A begins the cycle. The method begins (block 10) by clearing the list of survey paths (block 12) found on the last cycle (block 80). A first BS sector with which communication is established is set as the first sector under consideration for the searching process (block 14). The searcher element
5 searches a window of time around the expected arrival time of signals from the sector under consideration (block 16). The three strongest local maxima from the search of the sector under consideration are determined (block 18). In this example, finding more than the three strongest is ineffectual because only three demodulation elements are available for assignment and in no case would a
10 demodulation element be assigned to the fourth largest survey path from a single BS sector.

In the exemplary embodiment, a local maximum is found within the search window based on the use of survey samples that are spaced 0.5 chips apart in time. If a smaller survey sample resolution is used, a single signal path
15 would likely create more than one distinct peak. In such a system, the distinct peaks could be used to create a single local maximum for the purposes of demodulation element assignment.

Each of the three maxima that has a signal strength that is stronger than a threshold value are added to the survey paths (block 20). If there are more
20 sectors in the active set (block 22), the next sector in the active set is set for consideration (block 26) and the method continues to search a time window around the new sector under consideration (block 16) and the method proceeds as discussed above. If the sector under consideration is the last sector to be searched, the survey list is complete (block 22).

25 Having attained the set of survey paths, the method continues in FIG. 1B (connecting block 24). The demodulation path under consideration is set to "D" (block 32). The lock/unlock state of the demodulation element corresponding to the demodulation path under consideration is checked (block 34). If the demodulation element is unlocked the controller may de-assign the
30 demodulation element or it may label the demodulation element "free" (block 50). In such a case no valid data exists to match to the survey paths. Action corresponding to the demodulation path under consideration is complete and

the method continues to determine whether there are more demodulation paths (block 46). If yes, then "D" is set as the next demodulation path (block 48) and it is determined whether D is in lock as outlined above (block 34).

5 If the demodulation element under consideration is currently in lock (block 34), the method attempts to match the time offset of the demodulation path to the analogous information in the list of survey paths (block 36). In general, each demodulation path matches with at least one survey path. In other words, if a path from a BS is strong enough to be demodulated, it should be detectable by the searcher element. On occasion, the searcher element may miss a path and therefore not enter a survey path corresponding to a demodulation path on the survey path list. The demodulation element more accurately estimates the signal level and time offset of a path than the searcher element. Therefore the method assumes that the demodulation element is accurate and that such a path does exist. Therefore if there is no survey path entry for a demodulation path, a survey path entry corresponding to the demodulation path is created (block 52). Action corresponding to the demodulation path under consideration is complete and the method determines whether there are more demodulation paths for consideration (block 46). If yes, "D" is assigned as the next demodulation element path (block 48) and the method continues as outlined above to determine whether D is in lock and so forth (block 34).

25 If a survey path exists that corresponds to the demodulation path under consideration, the method determines whether the demodulation path under consideration is the first demodulation path to match the particular survey path (block 38). If the demodulation path under consideration is the first, action corresponding to the demodulation path under consideration is complete and the method determines whether there are more demodulation paths for consideration as set forth above (block 46).

30 If the demodulation path under consideration is not the first demodulation path to match the particular survey path, two demodulation elements are demodulating substantially the same path. This scenario can be a common occurrence. Each demodulation element tracks the signal to which it

was originally assigned. Commonly two multipath signals over time merge into one path or nearly the same path. Block 38 identifies such a situation. If the demodulation path under consideration is not the first demodulation path to match a particular survey path, then it is determined which demodulation path
5 has the stronger signal level (block 40). If the demodulation element under consideration has the stronger signal level, the previous demodulation element having a path matching this same survey path is de-assign or labeled free (block 42). If the demodulation element under consideration is weaker than the previous path, the demodulation element corresponding to the demodulation
10 path under consideration is de-assigned or labeled free (block 44). Action corresponding to the demodulation path under consideration is complete.

If a demodulation path exists that has not yet been considered (block 46), the next demodulation path under consideration is selected (block 48) and the process is repeated for that demodulation path (block 34, etc.). If the
15 demodulation path under consideration is the last demodulation path to be considered, then the method of assigning finger assignment to assure cell diversity begins (block 54).

Having attained the set of survey paths and matched the demodulation paths to the survey paths, the method continues to FIG. 1C (block 54). The
20 survey path with the strongest signal level is taken under consideration and set as "P" (block 60). The cell containing P is set to "C" and the sector containing P is set as "S" (block 60).

The algorithm of FIG. 1C focuses on covering as many cells as possible to insure that at least one finger is demodulating a path which supports supplemental
25 channels. However as discussed above, an alternate implementation of the present invention could emphasize BS diversity independent of sectors.

The algorithm begins by assigning the fingers to the strongest paths in the survey list. If a demodulation element is assigned to the cell C under consideration (block 62), and then if more paths are on the path list (block 74),
30 the method will cycle through the paths on the path list beginning with the strongest to the weakest (blocks 62, 74, 70) until a cell containing a survey path is found which doesn't have any fingers assigned to it (block 62). If the survey

path under consideration is the last survey path to be considered, and the fingers are all assigned to cells (block 62), then a finger assignment to accomplish path diversity begins (block 94) as shown in FIG. 1D.

If no finger exists having a demodulation path corresponding to the survey path under consideration, and if any fingers are unassigned (block 64), the unassigned finger is assigned to that path (block 72). Then if there are more paths in the path list (block 74), the "P" is assigned as the next strongest path in the path list for consideration (block 70) and the cycle continues (block 62). After all the fingers have been assigned (block 64), then the method begins a process of insuring that there are not more than one fingers demodulating each cell. The weakest finger "F" (block 65) is first evaluated to determine whether to reassign a finger. If there is another finger assigned to the weakest finger's cell (block 66), then the other finger is reassigned to the path under consideration (76) and the cycle begins again at FIG. 1A.

If there are no other fingers assigned to the weakest finger F's cell (block 66), and there are more fingers (block 69), "F" is assigned as the next weakest finger (block 67) and it is determined whether there are any other fingers assigned to F's cell (block 66), and so forth as described above. In this manner, the method insures that each cell only has a single finger demodulating it.

If there are no double assignments of fingers to cells (block 66) and there are no more fingers (block 69), it is determined whether any of the fingers are already demodulating a supplemental channel (block 80). If there are not any fingers already demodulating a supplemental channel, it is determined whether the sector "S" containing the path P supports supplemental channels (block 82). If fingers are already demodulating a supplemental channel or channels (block 80), then it is determined whether the signal level of the demodulation path for comparison is more than 3 dB weaker than the signal level of the survey path under consideration (block 68). The 3 dB data is the hysteresis window to prevent excessive re-assignment between two similarly advantageous paths. Larger or smaller hysteresis windows could be used depending on the system application.

If the weakest finger is at least 3 dB weaker than the survey path, then it is determined whether the weakest finger F is the only one supporting supplemental channels (block 86).

Returning to block 80, if there are no fingers already supporting
5 supplemental channels, it is determined whether the sector S containing the path under consideration supports supplemental channels (block 82). If the cell does not support supplemental channels, it is determined whether the weakest finger is at least 3 dB less than P (block 68), as discussed above. If the cell does support supplemental channels (block 82), then it is determined whether the
10 strongest path P plus a differential amount delta is greater than the weakest finger (block 84). If yes, then the finger corresponding to the demodulation path for comparison is re-assigned to the survey path under consideration (block 76). This re-assignment is the sole re-assignment for this cycle and the cycle beings over at FIG. 1A (block 92). The assignment involves assigning an
15 unassigned finger, of one exists, to the particular survey path having a corresponding transmitter index that is different from every other transmitter index in the list of demodulation paths. The assignment of the un-assigned finger depends on whether a finger is demodulating information on a Supplemental Channel to insure that at least one finger is assigned to a
20 transmitter that is transmitting on Supplemental Channels.

Returning to block 84, if the path P plus a differential amount is not greater than the weakest finger, then the re-assignment of block 76 is bypassed and the finger reassignment algorithm for maximizing cell diversity as shown in FIG. 1D is executed (block 94). The value of delta can be manipulated to
25 choose the threshold of when to reassign the finger to the path P when that sector S supports supplemental channels but no fingers are presently demodulating supplemental channels. Delta may be between +/- 20dB or more.

Continuing at block 68, if the signal level of the weakest finger used for
30 comparison is greater than 3 dB weaker than the signal level of the survey path under consideration, then it is determined whether the weakest finger is the only one supporting supplemental channels (block 86). If yes, then it is

determined whether the sector containing the path P under consideration supports supplemental channels (block 88). If no, then that finger is reassigned to the path P (block 76) and the cycle begins again in FIG. 1A (block 92). In this case, although there is no finger supporting supplemental channels, the sector
5 containing the path P supports supplemental channels and if data begins to be transmitted on the supplemental channel, the sector already has a path being demodulated to handle the data.

If the weakest finger is the only one supporting supplemental channels (block 86), and if the sector does support supplemental channels (block 88), then
10 the process proceeds to reassign that finger to the path P under consideration (block 76) and the cycle begins again (block 92).

Returning to block 86, if the finger with the weakest signal level is not the only one supporting supplemental channels, then the cycle proceeds to block 76 and that finger which corresponds to the demodulation path for
15 comparison is re-assigned to the path P under consideration (block 76), following which the cycle beings over at FIG. 1A (block 92). In this manner, if more than one finger is supporting supplemental channels, the strongest finger will be reassigned to the path P. Returning to block 88, if the sector containing the path P under consideration does not support supplemental channels, then it
20 is determined whether the high data rate call uses supplemental channels and whether there are any fingers not demodulating supplemental channels (block 90). If there are more fingers which are not demodulating supplemental channels, and the call is a HDR call with supplemental information, then there must be more paths on the survey list which have not been considered.
25 Therefore, the method returns to continue to survey the paths on the path list(block 74) and the process proceeds as above. Block 90 insures that the survey list of paths is exhausted to take advantage of every opportunity to assign fingers to supplemental channels. If there are fingers demodulating supplemental channels(block 90), then there is no need to reassign or to
30 continue to test the survey path list and the finger reassignment algorithm for maximizing sector and path diversity as shown in FIG. 1D is executed (block 94).

The benefit of this procedure is that at least one finger is assigned to a cell that is transmitting on supplemental channels, if supplemental data is being transmitted on supplemental channel. The method of FIGS 1A-1D first maximizes cell diversity in FIG. 1C and then focuses on sector and path diversity in FIG. 1D to insure that supplemental channels are always demodulated.

Turning to FIG. 1D, the strongest path in the path list is set as "P" and the cell containing P is set as "C", and the sector containing P is set as "S" (block 98). To maximize sector diversity, it is determined whether a finger is assigned to demodulate the path P (block 106). If yes, the method determines whether there are any more paths on the path list (block 104). If there is no finger assigned to P, it is determined whether any finger is free or unassigned (block 108). If an unassigned or free finger exists, the unassigned or free finger is assigned to P (block 102) and action corresponding to the survey path under consideration is complete and it is determined whether there are more paths on the path list (block 104).

From block 104, if there are more paths on the path list, the process continues for the next strongest survey path, which is assigned as "P" and assigns "C" as the cell containing P (block 100). If an additional survey path does not exist, the flow continues through connection block 80 to FIG. 1A to clear the list of survey paths and being the cycle again (block 12).

Returning to block 108, after the strongest paths are assigned fingers and there are no fingers remaining, then the algorithm insures that any data on supplemental channels will be demodulated. The weakest finger is assigned as "F" (block 110). It is then determined whether the weakest finger F is assigned to cell C (block 112). If yes, then it is determined whether the weakest finger F is the only one demodulating Supplemental Channels (block 114). Blocks 114 and 116 insure that a finger is not removed that is the only one demodulating supplemental channels.

If finger F is the only one demodulating the cell C, it is determined whether the sector containing the path P under consideration supports Supplemental Channels (block 116). If sector S does not support supplemental

channels, then the algorithm does not reassign fingers but keeps the finger F as the sole demodulating finger of the Supplemental Channel. The method begins again (block 80) to clear the list of survey paths (block 12) as shown in FIG. 1A.

If the sector S supports Supplemental Channels (block 116), then the
5 finger F being considered is not the only one demodulating Supplemental Channels. It is determined whether the finger F is weaker than P by 3dB (block 118). The value 3dB is used by example, but a range of +/- 20dB or more may be used to vary the output of block 118 as to whether a finger gets reassigned in block 120. If F is weaker than P by 3dB, then the finger F is reassigned to the
10 path P (block 120) and the list of survey paths is cleared (blocks 80, 12). If finger F is not weaker than P by 3 dB, then the reassignment does not occur and the list of survey paths is cleared (block 80, 12).

Returning to block 112 of FIG. 1D, if the weakest finger F is not assigned to the cell containing the path P, then it is determined whether there is another
15 finger assigned to F's cell (block 122). If yes, the method proceeds to block 114 and continues as described above. If no, then it is determined whether there are any more fingers (block 124). If there are no more fingers, then the list of survey paths is cleared and the cycle begins again (blocks 80, 12). If there are more fingers as determined by block 124, then the finger "F" is assigned as the next
20 weakest finger (block 126), and continues with the determination of whether F is assigned to the cell containing the path P (block 112) and so forth as described above from block 112.

In block 118, the 3 dB offset is the hysteresis window to prevent excessive re-assignment between two similarly advantageous paths. Larger or
25 smaller hysteresis windows could be used depending on the system application. If such a 3 dB weaker path exists, the finger corresponding to the weakest such demodulation path is reassigned to the survey path (block 120). This re-assignment is the sole re-assignment for this cycle and the flow continues through connection block 80 to the beginning of a new cycle on FIG.
30 1A. The assignment involves assigning an unassigned finger, if one exists, to the particular survey path having a corresponding transmitter index that is different from every other transmitter index in the list of demodulation paths.

The assignment of the un-assigned finger depends on whether a finger is demodulating information on a Supplemental Channel to insure that at least one finger is assigned to a transmitter that is transmitting on Supplemental Channels.

- 5 If no such 3 dB weaker path exists, the remaining survey paths would flow through FIG. 1D in the same manner as the demodulation path under consideration. Therefore if no such path exists, meaning that no re-assignments have occurred during this cycle, flow continues from block 120 through connection block 80 to FIG. 1A.
- 10 By way of example let us assume that the method of FIGS. 1A-1D is executed based on the signals shown in FIGS. 3A-3C. Assume that no other BS sectors are available to the mobile station. Assume that the three demodulation elements are assigned as follows:

Demod. Element	Time offset	Signal Level	Locked	Sector
1	t_1	A_1	Y	3A
2	t_2	A_2	N	3A
3	t_3	A_3	Y	3A

- 15 where the sector corresponds to the Figure numbers in FIGS. 3A-3C. For example; the signal shown in FIG. 3A corresponds to sector 3A, and so forth. Beginning with FIG 1A, the survey list is cleared and sector 3A is set as the first sector under consideration (blocks 10-14) as part of the Active Set. The searcher
- 20 element begins a search for the multipath signals as shown in FIG. 3A and labeled as follows:

Path label	time offset	Signal level	Sector
300	t_{10}	A_{10}	3A
302	t_{11}	A_{11}	3A
304	t_{12}	A_{12}	3A
306	t_{13}	A_{13}	3A

Path 304 is the smallest of the four levels and is below the threshold level as indicated by threshold line 320. The searcher element finds three maxima (blocks 16-20). Therefore the final data added to the list of survey paths for this cycle is as follows:

Path label	time offset	Signal level	Sector
300	t_{10}	A_{10}	3A
302	t_{11}	A_{11}	3A
306	t_{13}	A_{13}	3A

5

Sector 3B is set as the next sector under consideration (blocks 22 and 26).

Two more entries are added to the list of survey path as follows (blocks 16-20):

Path label	time offset	Signal level	Sector
308	t_{14}	A_{14}	3B
310	t_{15}	A_{15}	3B

Sector 3C is set as the next sector under consideration (blocks 22 and 26).

10 Two more entries are added to the list of survey paths as follows (blocks 16-20):

Path label	time offset	Signal level	Sector
312	t_{16}	A_{16}	3C
314	t_{17}	A_{17}	3C

Thus the list of survey paths is complete and the flow continues to FIG. 1B.

FIG. 1B begins by setting the path of demodulation element 1 to be the first path under consideration. Because demodulation path 1 is locked, the demodulation path is matched to a survey path (block 34-36). Suppose in this example that t_1 is approximately equal to t_{10} and thus demodulation path 1 matches to survey path 300. Because demodulation path 1 is the first demodulation path to match survey path 300, the process continues for the next demodulation path (blocks 38 and 46).

20 Demodulation path 2 is set as the demodulation path under consideration (block 48). Because demodulation path 2 is unlocked,

demodulation path 2 is labeled free (blocks 34 and 50). The process continues for the next demodulation path (block 46).

Demodulation path 3 is set as the demodulation path under consideration (block 48). Because demodulation path 3 is locked, the demodulation path is matched to a survey path (block 34-36). Suppose in this example that t_3 is also approximately equal to t_{10} and thus demodulation path 3 matches to survey path 300 as did demodulation path 1. Because demodulation path 3 is the second demodulation path to match survey path 300, the process compares the amplitude of the two paths (block 38 and 40). In this example suppose that $A_3 < A_1$ and therefore demodulation element 3 is labeled free (block 44). Because demodulation path 3 is the last demodulation path, the functions of FIG. 1B are complete and the flow continue to FIG. 1C with the following list of demodulation paths:

Demod. Element		time offset	Signal level	Locked	Sector
	1	$t_1 = t_{10}$	A_1	Y	3A
FREE	2				
FREE	3				

and the following list of survey paths:

Path Label	time offset	Signal level	Sector	Matched
300	t_{10}	A_{10}	3A	Demod path 1
302	t_{11}	A_{11}	3A	
306	t_{13}	A_{13}	3A	
308	t_{14}	A_{14}	3B	
310	t_{15}	A_{15}	3B	
312	t_{16}	A_{16}	3C	
314	t_{17}	A_{17}	3C	

Assuming that A_{14} is the strongest signal level, the method as shown in FIG. 1C begins by setting survey path 308 as the survey path "P" under consideration,

3B as the sector "S" containing that path (block 60) and "C" as the cell containing the path P. In this example, no demodulation element is assigned to sector 3B and demodulation element or finger 2 is free (blocks 62 and 64). Therefore demodulation element 2 is assigned to survey path 308 and the new list of

5 demodulation paths is as follows:

Demod. Element	time offset	Signal level	Locked	Sector
1	t_1	A_1	Y	3A
2	t_{14}	A_{14}	Y	3B
FREE 3				

Assuming that A_{11} is the next strongest signal level, survey path 302 is

10 the next survey path under consideration and 3A is the sector containing that path (blocks 74 and 70). Because there is already a demodulation element assigned to sector 3A, survey path 310 is set as the next survey path under consideration and 3B as the sector containing that path (blocks 62, 74, and 70), assuming that A_{15} is the next strongest signal level. This process continues

15 through survey paths 300 and 306, assuming that A_{10} and A_{13} follow in order of signal strength. When survey path 314 is the path under consideration and 3C is the sector containing that path, previously free demodulation element 3 is assigned to survey path 314 (blocks 62, 64, and 72). Survey path 312 is set as the survey path under consideration (blocks 74 and 70) and because demodulation

20 path 3 is assigned to sector 3C the functions of FIG. 1C are complete (block 62, and 74) and as the list of demodulation paths is as follows:

Demod. Element	Time offset	Signal level	Locked	Sector
1	t_1	A_1	Y	3A
2	t_{14}	A_{14}	Y	3B
3	t_{17}	A_{17}	Y	3C

In this scenario, no demodulation element has been reassigned up to this point, so the flow continues to FIG. 1D for further path and sector diversity. Survey path 308 is again set as the survey path under consideration (block 98) because A_{14} is the strongest signal level. Because survey path 308 is assigned to demodulation element 2, the process continues with survey path 302 as the survey path under consideration (blocks 108, 106, 104, and 100) because A_{11} as discussed above is the next strongest signal path. Next, survey path assigned is 310 because A_{15} is the next in line of strength. Then demodulation element 1 is reassigned to survey path 302. This assignment ends the process of this cycle. The survey path is cleared (block 12) for the next cycle and the list of demodulation paths is as follows:

Demod. Element	Time offset	Signal level	Locked	Sector
1	t_{11}	A_{11}	Y	3A
2	t_{14}	A_{14}	Y	3B
3	t_{17}	A_{17}	Y	3C

Once all the fingers are assigned (block 108), we turn to maximizing the coverage for paths and sectors according to the above cell assignments. If there is only one demodulation element (1,2 or 3) that is demodulating a supplemental channel, the method and apparatus of the present invention insures that that demodulation element will not be removed from the supplemental channel (blocks 114, 116). Or, if a sector of the cell supports supplemental channels, and the finger F is weaker than the path P under consideration by 3dB, then the method will reassign the finger F to the path P. In this manner, the method will maximize the strength of the demodulation elements demodulating supplemental channels.

The base station method is less complicated than the mobile station method. Unlike the mobile station, the BS having multiple sectors is not concerned with sector diversity because no analogous power control information is sent from the mobile station. The base station method focuses on

assigning all available demodulation elements to the strongest paths while avoiding excessive re-assignments.

There are many obvious variations of the embodiments of this invention. The previous description of the preferred embodiments is provided to enable
5 any person skilled in the art to make or use the present invention. The various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the present invention is not intended to be limited to the embodiments shown herein but is
10 to be accorded the widest scope consistent with the principles and novel features disclosed herein.

We claim:

CLAIMS

1. In a communication device, a method of assigning a plurality of
2 fingers to a plurality of signals, the method comprising:
measuring said plurality of signals;
4 creating list of survey paths corresponding to said plurality of signals;
matching a list of demodulation paths to said list of survey paths;
6 assigning said plurality of fingers to the paths in said list of survey paths;
and re-assigning a finger to a demodulation path based on whether any
8 finger is demodulating a supplemental channel to insure that at least one finger
demodulates a supplemental channel.

2. A method of assigning a plurality of fingers to a plurality of
2 demodulation paths comprising:
measuring said plurality of signals;
4 creating list of survey paths corresponding to said plurality of signals;
matching a list of demodulation paths to said list of survey paths;
6 assigning said plurality of fingers to the paths in said list of survey paths
in order to establish cell diversity and based on path strength;
8 re-assigning a finger to a demodulation path based on whether any
finger is demodulating a supplemental channel to insure that at least one finger
10 demodulates a supplemental channel; and
assigning said plurality of fingers to the paths in said list of survey paths
12 in order to establish path diversity.

3. The method of claim 1 further comprising the steps of:
2 re-assigning a particular finger to said particular survey path if no
un-assigned finger exists, said re-assigning comprising:
4 un-assigning said particular finger; and

assigning said particular finger to said particular survey path,
6 subject to insuring that at least one finger is assigned to a transmitter that is
transmitting supplemental channels, if one exists.

4. The method of claim 1, wherein said method occurs during a high
2 data rate call.

5. A method of assigning fingers to a plurality of demodulation paths
2 comprising:

creating a survey list of said demodulation paths;
4 assigning said fingers to said demodulation paths in said survey list
based on path strength;

6 re-assigning a finger to a demodulation path under consideration if there
is more than one finger assigned to a cell containing said demodulation path
8 under consideration; and

if each cell is assigned a single finger, reassigning a finger to said
10 demodulation path under consideration if no fingers are already demodulating
supplemental channels and if a sector containing said demodulating path under
12 consideration supports supplemental channels.

6. The method of claim 5 further comprising:
2 un-assigning a particular finger; and
assigning said finger to one of said existing demodulation paths on said
4 survey list, subject to insuring that at least one finger is assigned to a
transmitter that is transmitting supplemental channels, if one exists.

7. The method of claim 5, wherein said method occurs during a high
2 data rate call.

8. A mobile communication device for demodulating a plurality of
2 signal paths comprising:
a set of fingers for demodulating a set of survey paths;
4 a control system which conducts a survey of pilot signals from a base
station and creates a set of survey paths, said control system matching the
6 survey paths with the fingers, said control system assigning a finger to a path in
said set of survey paths dependent on whether any finger is demodulating a
8 supplemental channel to insure that at least one finger is assigned to a source
that is transmitting on supplemental channels, if one exists.

9. The mobile communication device of claim 8 wherein said control
2 system:
un-assigns a particular finger if no unassigned finger exists; and
4 assigns said particular finger to a particular instance of said signal.

10. The communication device of claim 9, wherein said particular
2 finger was assigned to an instance of said signal having a signal strength that is
weaker than the signal strength of any other instance of said signal from said
4 first set of instances of said signal.

11. The apparatus of claim 10 wherein said particular finger
2 corresponds to an instance of said signal having a signal strength that is weaker
than said signal strength of said particular instance of said signal.

12. A method for processing a signal comprising:
2 measuring a series of energy levels of said signal;
generating a series of electronic representations of said signal based on
4 said series of energy levels;
searching said series of electronic representations for a set of forward
6 link signals;

demodulating a sub-set of forward link signals that contains at least one
8 forward link signal for each transmitter, said at least one forward link signal
having a greater signal strength than a remaining set of all other forward link
10 signals also associated with said transmitter; and

matching said first set of instances of said signal with said second set of
12 instances of said signal, and for assigning an un-assigned finger, if said
un-assigned finger exists, to a particular instance of said signal from said
14 second set of instances of said signal, said particular instance having a
corresponding transmitter index that is different than every transmitter index
16 from said first set instances of said of signal, said assigning being dependent on
whether any finger is demodulating a supplemental channel to insure that at
18 least one finger is assigned to a source that is transmitting on supplemental
channels, if one exists.

13. The method of claim 12, wherein said method occurs during a
2 high data rate call.

14. The method of claim 12, wherein the signal processing occurs
2 during a code decision multiple access forward link transmission

15. A communication system comprising:
2 at least one base station;
a mobile station transmitting and receiving communications signals to
4 and from said at least one base station;
a control system which assigns fingers to demodulate communication
6 signals received by said mobile station, said control system determining after all
said fingers have been assigned to demodulate communication signals whether
8 any of the fingers are demodulating communication signals on supplemental
channels;

10 said control system reassigning a finger to demodulate said
 supplemental channel if no fingers assigned are demodulating communication
12 signals on said supplemental channel.

 16. In a mobile station, a method of assigning a plurality of fingers
2 comprising:
 creating a list of survey paths corresponding to a plurality of
4 demodulation paths;
 assigning fingers to demodulation paths corresponding to the list of
6 survey paths based on path strength;
 determining whether any fingers are demodulating a supplemental
8 channel; and
 if the weakest finger demodulating a supplemental channel is not the
10 only finger demodulating a supplemental channel, re-assigning a non-weakest
 finger demodulating supplemental channels to the path.

 17. The method of claim 16, further comprising
2 if no fingers are demodulating supplemental channels, determining
 whether the sector containing the path under consideration supports
4 supplemental channels, and if said sector supports supplemental channels,
 reassigning a finger to the path in said sector.

 18. The method of claim 17, further comprising determining whether
2 the strength of the path is above a predetermined threshold value before
 reassigning the finger to the path in said sector.

 19. The method of claim 16, further comprising determining if the
2 weakest finger is at least 3dB weaker than the path under consideration before
 determining whether the weakest finger demodulating a supplemental channel
4 is not the only finger demodulating a supplemental channel .

20. The method of claim 16, further comprising:
2 if the weakest finger is the only finger supporting supplemental
channels, determining whether the sector containing the path under
4 consideration supports supplemental channels.

21. The method of claim 21, further comprising:
2 if said sector supports supplemental channels, re-assigning a finger to
said path under consideration thus insuring that the information on a
4 supplemental channel is always demodulated by a finger during a soft-handoff
in a high data rate call.
6

22. The method of claim 21, further comprising:
2 if said sector does not support supplemental channels, determining
whether said mobile station is on a high data rate call using supplemental
4 channels and whether there are no fingers demodulating supplemental
channels.

23. The method of claim 23, further comprising:
2 if no fingers are demodulating supplemental channels in said high data
rate call, continuing to consider the remaining paths on said list of survey paths.

24. A communication system comprising:
2 at least one base station;
a mobile station transmitting and receiving communication signals to
4 and from said at least one base station, said mobile station have a plurality of
fingers which demodulate a set of instances of said communication signals
6 received from said at least one base station;
a control system which assigns said fingers to said set of instances of said
8 communication signals received from said at least one base station such that if

one base station is transmitting a communication signal on a supplemental
10 channel, said control system insures that a finger is assigned to demodulate said
supplemental channel.

25. A communication system comprising:
2 a plurality of base stations;
a mobile station communicating with said plurality of base stations;
4 a control system which assigns fingers to demodulation paths
transmitted from said plurality of base stations to said mobile station base on
6 demodulation path strength, said control system re-assigning a finger to one of
said plurality of base stations which is transmitting a supplemental channel, if
8 any, after determining that said finger is the only finger of the assigned fingers
which is demodulating the supplemental channel.

26. The communication system of claim 25, wherein said finger re-
2 reassigned to one of said plurality of base stations is the weakest finger.

27. The communication system of claim 25, wherein before
2 reassigning said finger, said control system determines whether a sector
containing the path supports supplemental channels.

28. The communication system of claim 27, wherein before
2 reassigning said finger and after determining whether the sector supports
supplemental channels, the control system determines whether the path under
4 consideration is stronger than a threshold value, and only if the path is at least a
threshold value will said control system reassigning the finger to the path.

29. A method of assigning fingers to a plurality of demodulation paths
2 comprising:
creating a survey list of said demodulation paths;

- 4 assigning said fingers to said demodulation paths in said survey list
based on path strength;
- 6 re-assigning a finger to a demodulation path under consideration if:
there is more than one finger assigned to a cell containing said
8 demodulation path under consideration;
each cell is assigned a single finger and if a sector containing said
10 demodulating path under consideration supports supplemental channels;
each cell is assigned a single finger, at least one finger is already
12 demodulating supplemental channels, and the weakest finger is not the only
one supporting supplemental channels; or
14 each cell is assigned a single finger, at least one finger is already
demodulating supplemental channels, the weakest finger is the only one
16 supporting supplemental channels, and a sector containing said demodulation
path under consideration supports supplemental channels.

30. The method of claim 29, further comprising assigning said fingers
2 to said demodulation paths such that there is a single finger assigned to a single
cell containing a demodulation path on said survey list.

31. The method of claim 29, further comprising:
2 re-assigning a finger to a demodulation path under consideration if:
each cell is assigned a single finger, if a sector containing said
4 demodulating path under consideration supports supplemental channels and
the path under consideration as a threshold value greater than the weakest
6 finger.

32. The method of claim 31, further comprising:
2 re-assigning a finger to a demodulation path under consideration if:
each cell is assigned a single finger, at least one finger is already
4 demodulating supplemental channels, the weakest finger is at least a threshold

value weaker than the path under consideration, and the weakest finger is not
6 the only one supporting supplemental channels.

33. The method of claim 32, wherein the threshold value is
2 approximately 3 dB.

34. A method of assigning fingers to a plurality of demodulation
2 paths comprising:
creating a survey list of said demodulation paths;
4 assigning said fingers to said demodulation paths in said survey list
based on path strength;
6 re-assigning a finger to a demodulation path under consideration if:
the weakest finger is assigned to the cell containing said
8 demodulation path under consideration and the weakest finger is not the only
one demodulating supplemental channels; or
10 the weakest finger is assigned to the cell containing said
demodulation path under consideration and the weakest finger is the only one
12 demodulating supplemental channels and the sector containing said
demodulation path under consideration supports supplemental channels.

35. The method of claim 34, wherein said assigning fingers to said
2 demodulation paths further comprises assigning a single finger to each
demodulation path.

36. The method of claims 1, 2, 5, 29 or 34 wherein the finger
2 reassigned to a demodulation path under consideration is the weakest finger.

37. A method of assigning a plurality of fingers to a plurality of
2 demodulation paths comprising:

creating list of survey paths corresponding to a plurality of
4 demodulation paths;

assigning said plurality of fingers to the demodulation paths in said list
6 of survey paths in order to establish cell diversity and based on path strength;

beginning with the weakest finger, determining whether there are
8 multiple fingers assigned to each finger's cell, re-assigning the demodulation
path to a new finger if a plurality of fingers are assigned to said each finger's
10 cell;

if a single finger is assigned to each cell, re-assigning a finger to a
12 demodulation path based on whether any finger is demodulating a
supplemental channel to insure that at least one finger demodulates a
14 supplemental channel, and if no finger re-assignment is made:

assigning said plurality of fingers to the demodulation paths in said
16 list of survey paths in order to establish path diversity;

re-assigning a finger to a demodulation path under consideration if:

18 the weakest finger is assigned to the cell containing said
demodulation path under consideration and the weakest finger is
20 not the only one demodulating supplemental channels; or

the weakest finger is assigned to the cell containing said
22 demodulation path under consideration and the weakest finger is
the only one demodulating supplemental channels and the sector
24 containing said demodulation path under consideration supports
supplemental channels.

38. The method of claim 37, wherein if a single re-assignment is
2 made, clearing the survey path list and restarting the finger assignment.

39. The method of claim 37, further comprising:

2 after assigning said fingers to the demodulation paths in said list of
survey paths in order to establish path diversity, reassigning a finger to said

- 4 path under consideration only if the finger to be reassigned is weaker than said path under consideration by a threshold amount.

40. The method of claim 37 wherein the threshold amount is
2 approximately 3 dB.

1/6

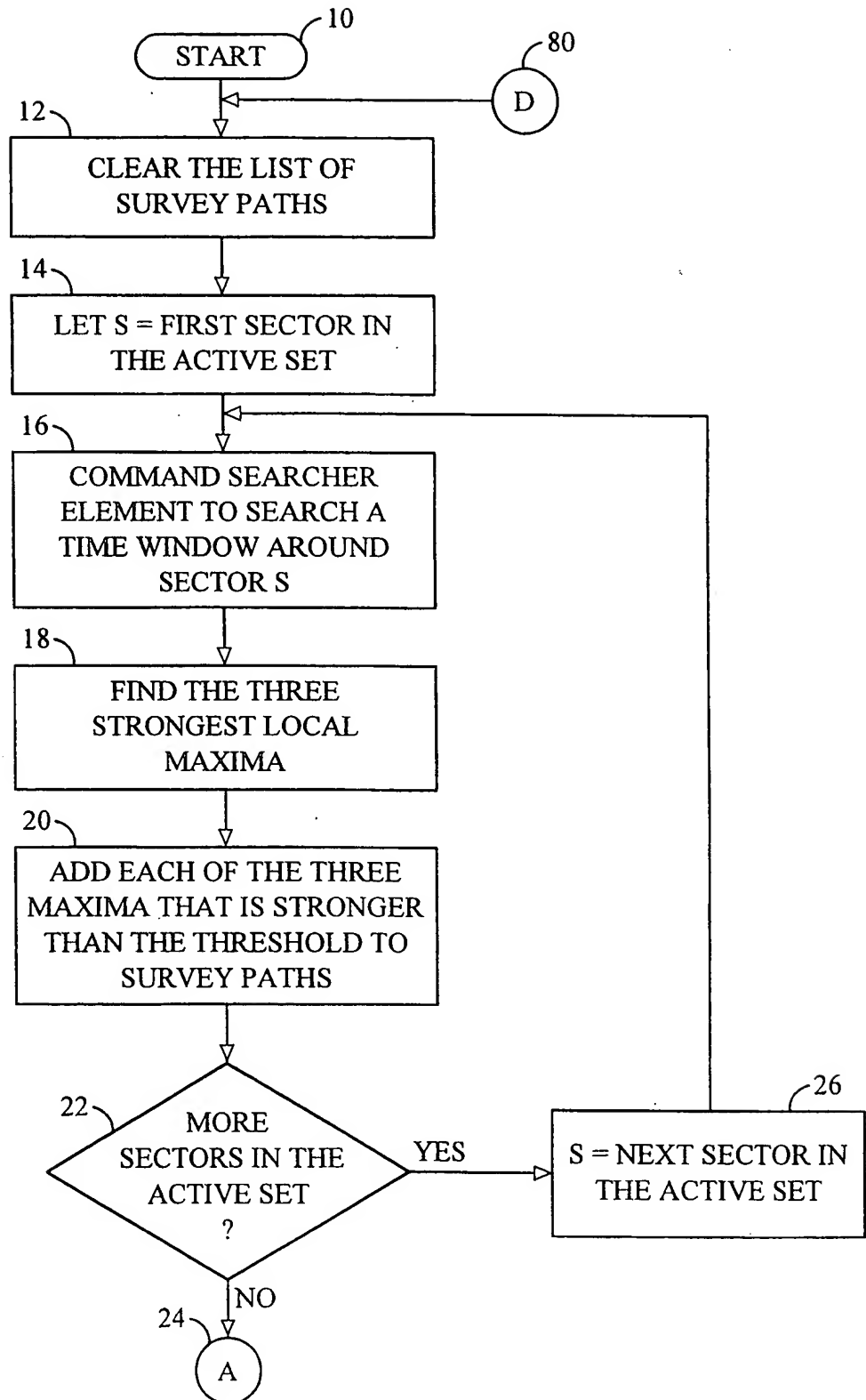


FIG. 1A

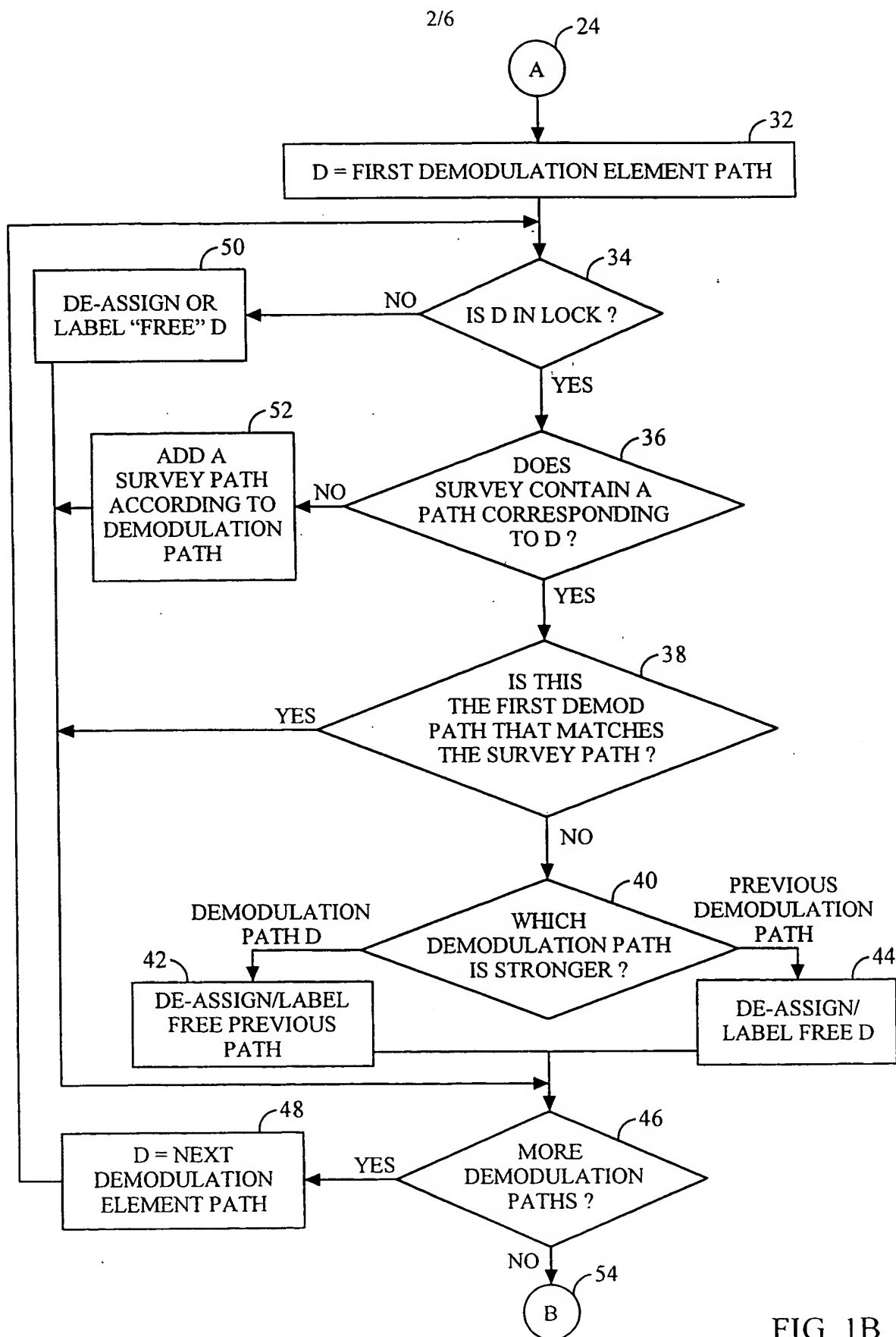
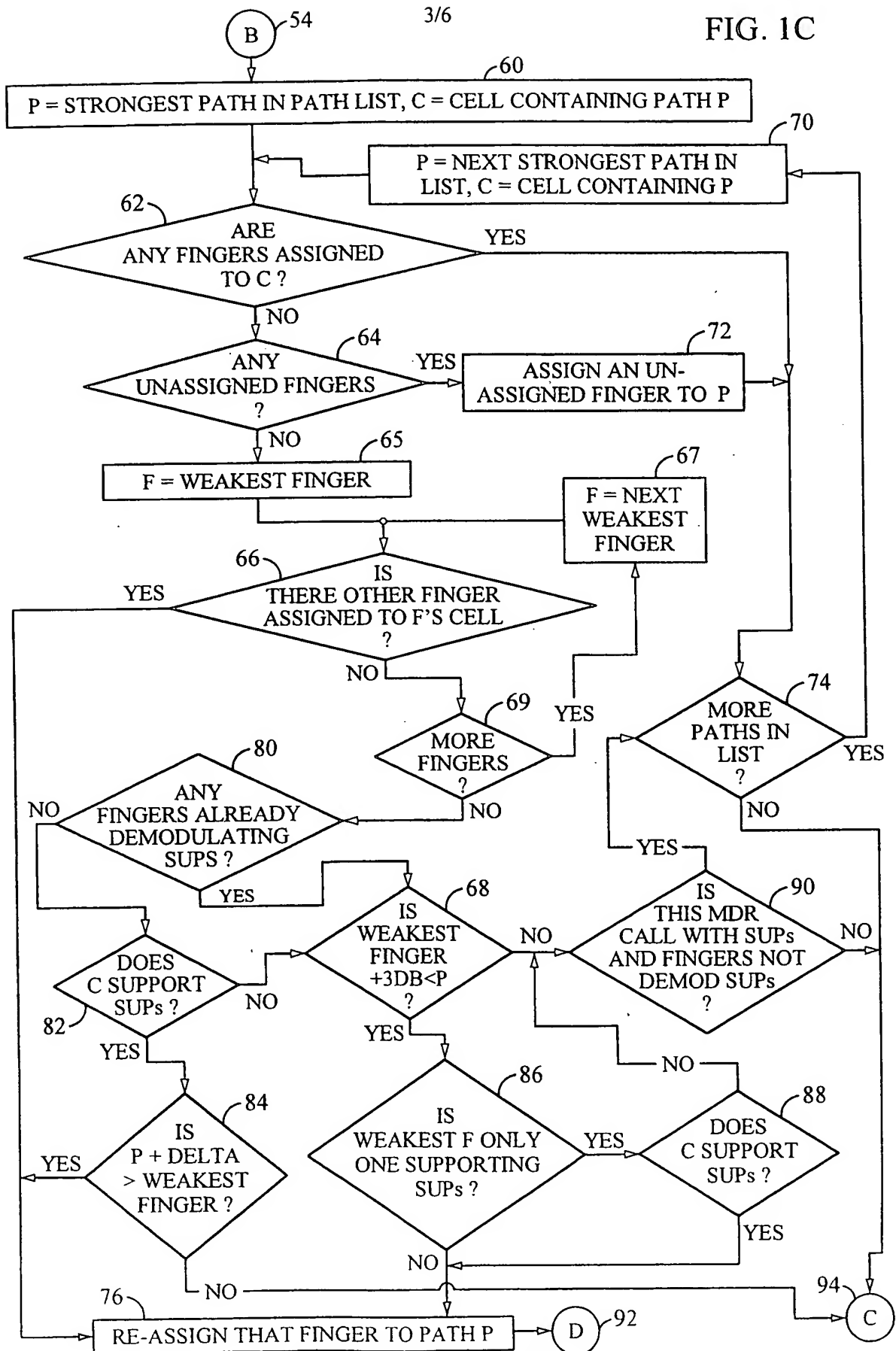


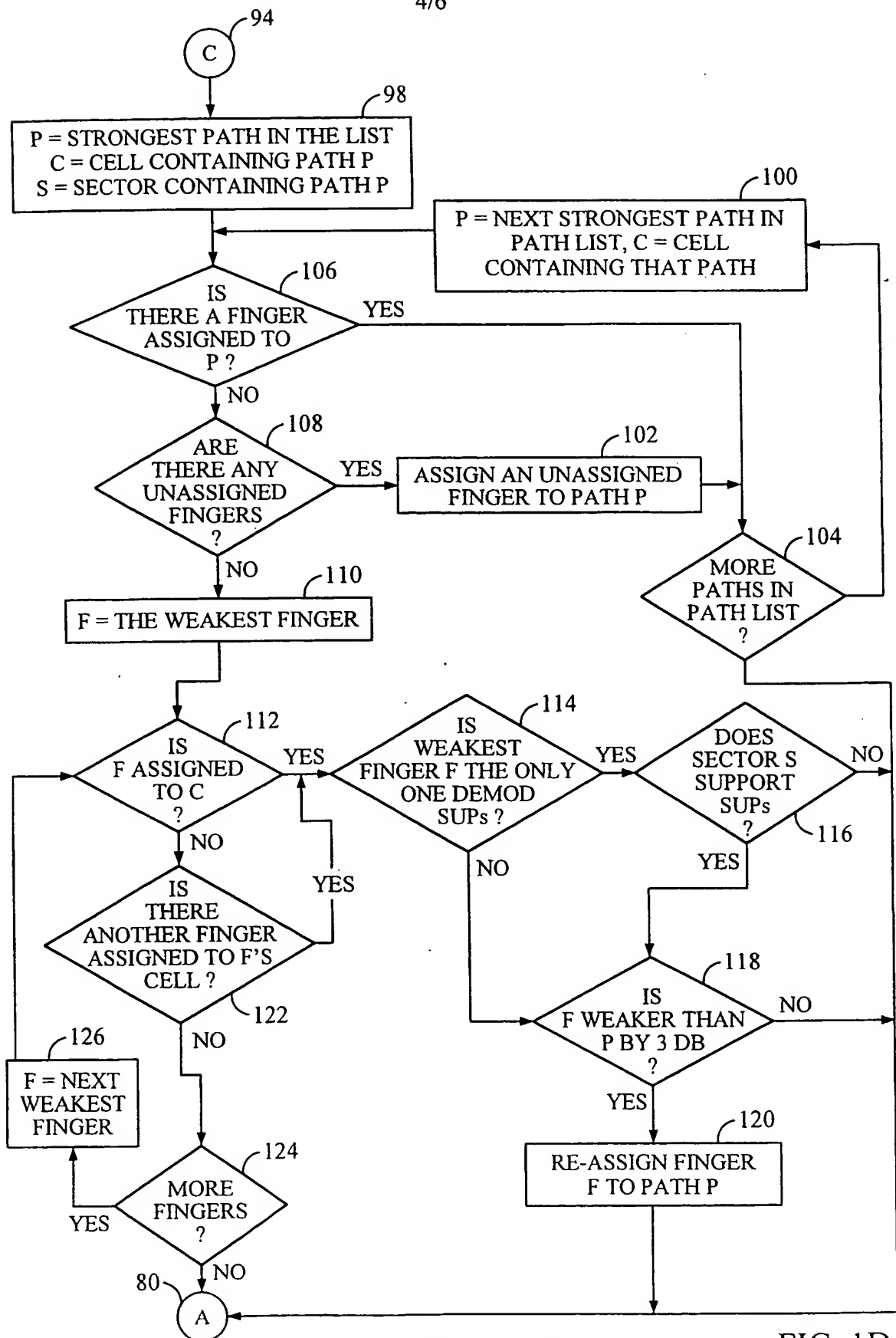
FIG. 1B

3/6

FIG. 1C



4/6



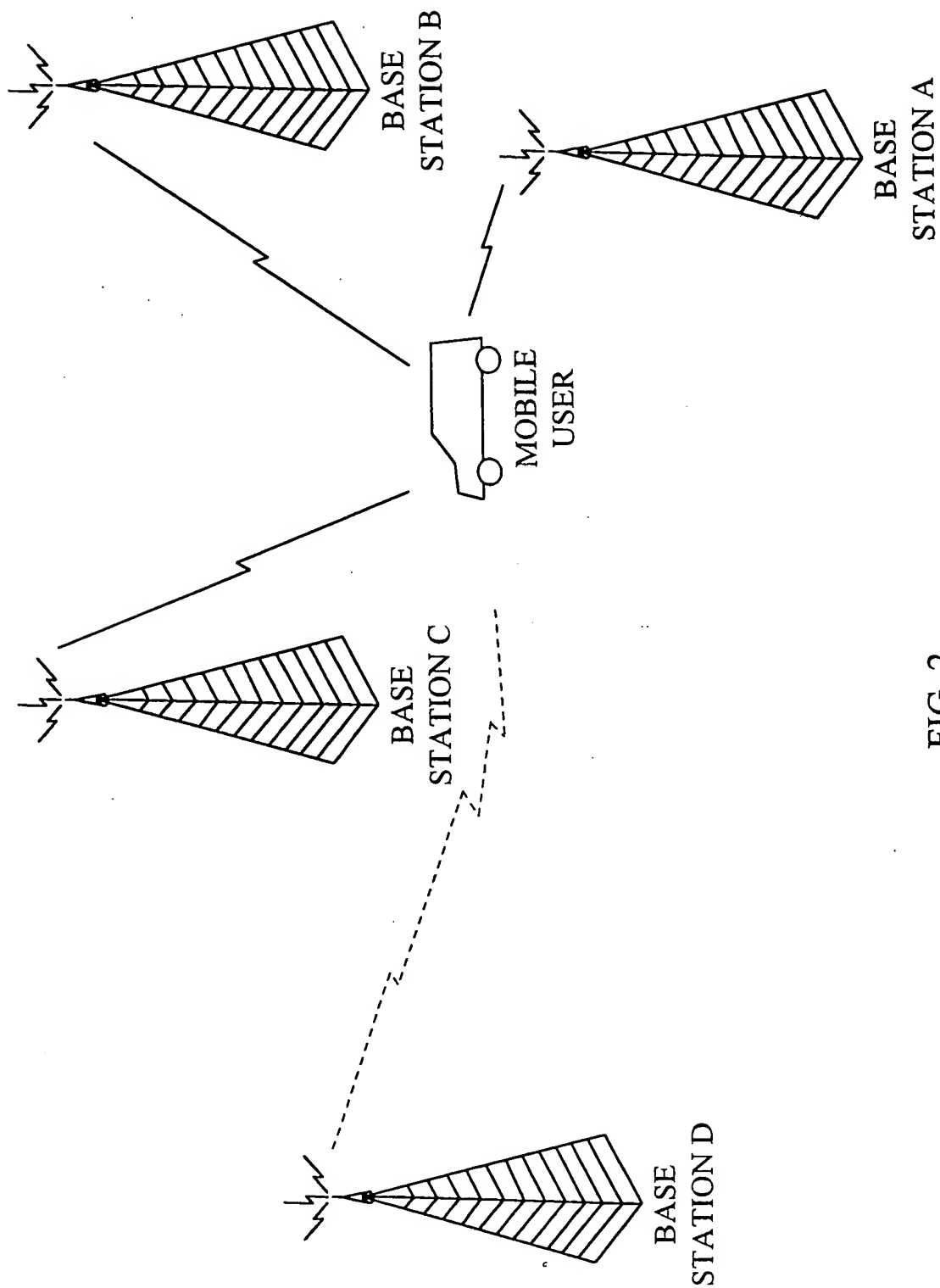


FIG. 2

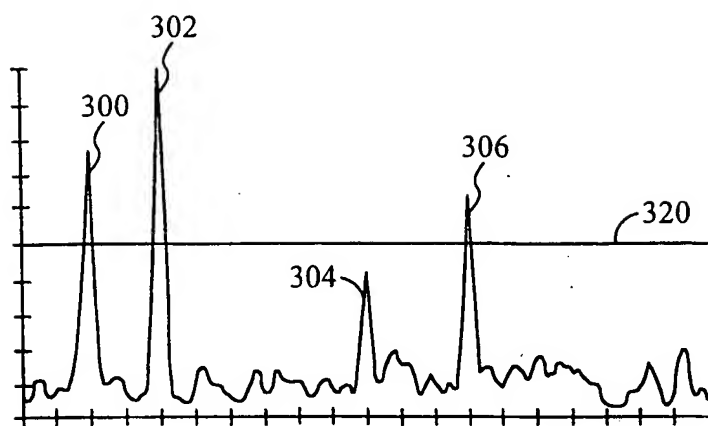


FIG. 3A

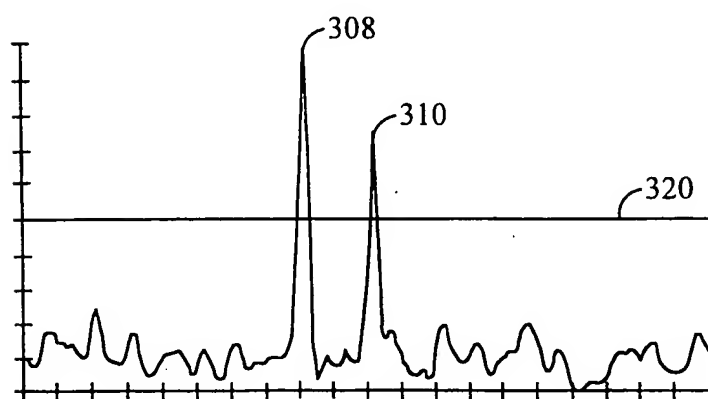


FIG. 3B

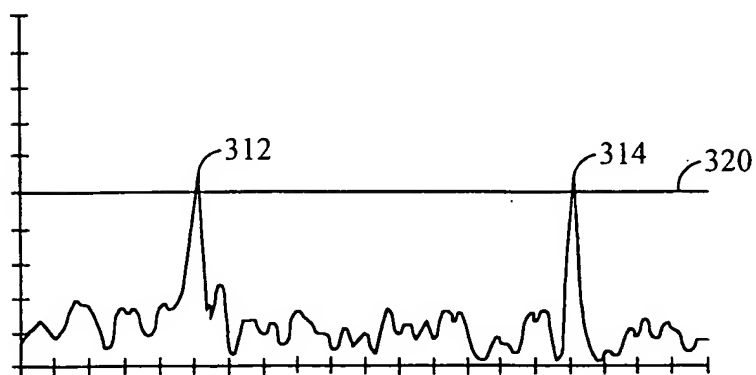


FIG. 3C

INTERNATIONAL SEARCH REPORT

Intern. Application No

PCT/US 00/25475

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B1/707 H04B7/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98 32263 A (QUALCOMM INC) 23 July 1998 (1998-07-23) page 3, line 35 -page 4, line 4 page 14, line 4 - line 32; figure 6 ---	1,2,5,8, 12,15, 16,24, 25,29, 34,37
A	EP 0 814 572 A (MATSUSHITA ELECTRIC IND CO LTD) 29 December 1997 (1997-12-29) column 7, line 26 -column 8, line 30 column 11, line 25 -column 12, line 2; claims 1-7; figure 6 --- -/--	1,2,5,8, 12,15, 16,24, 25,29, 34,37

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

G document member of the same patent family

Date of the actual completion of the international search

15 December 2000

Date of mailing of the international search report

29/12/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Nilsson, M

INTERNATIONAL SEARCH REPORT

Intern. Application No

PCT/US 00/25475

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>PRASAD, R.; OJANPERÄ, T.: "An Overview of CDMA Evolution toward Wideband CDMA" IEEE COMMUNICATIONS SURVEYS, 'Online! vol. 1, no. 1, 31 December 1998 (1998-12-31), pages 2-29, XP002155603</p> <p>Retrieved from the Internet: <URL:http://www.comsoc.org/pubs/surveys/4q98issue/pdf/Prasad.pdf> 'retrieved on 2000-12-14!</p> <p>page 9, left-hand column, line 9 -right-hand column, line 5; figure 14 page 10, left-hand column, line 23 -right-hand column, line 51; figure 15 page 15, left-hand column, line 9 - line 29; figures 19,20 page 25, left-hand column, line 44 -page 27, left-hand column, line 7; figure 38; table 5</p> <p>-----</p>	<p>1,2,5,8, 12,15, 16,24, 25,29, 34,37</p>

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern: .al Application No

PCT/US 00/25475

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9832263 A	23-07-1998	AU 5712898 A	07-08-1998
		BR 9714288 A	25-04-2000
		CN 1244983 A	16-02-2000
		EP 0956672 A	17-11-1999
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		US 5949814 A	07-09-1999
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Applic. # _____

Applicant: PETER JUNG ET AL.

Lerner and Greenberg, P.A.

Post Office Box 2480

Hollywood, FL 33022-2480

Tel: (954) 925-1100 Fax: (954) 925-1101